CONTAINER FOR THE STORAGE AND TRANSPORT OF SENSITIVE PLATE-LIKE OBJECTS

BACKGROUND OF THE INVENTION

[0001] The invention relates to a container for the storage and transport of sensitive plate-like objects, in particular of so-called surface functionalised glass substrates. These are small thin glass plates, the dimensions of which are comparable to microscope object holders. However, the surface functionalised glass substrates comprise additional sensitive coatings, and they serve as a preliminary stage in the manufacture of so-called biochips.

[0002] For the storage and transport of such glass substrates up to now the same containers were utilized that are also used for microscope object holders. Such containers are commercially available. However, it has been found that the known containers are not optimally suited for the purpose mentioned before, since during the storage and transport of surface functionalised glass substrates frequently undesired impairments of sensitive surfaces have occurred. A reason for this, as has been found by the inventors, are contaminations

which occur during storage and/or transport, even when the glass substrates are packed into the known containers under carefully known clean conditions.

[0003] In addition, the containers utilized up to now do not always protect the sensitive glass substrates against damages sufficiently. In particular, shock impacts that can occur when the container is dropped or is not treated during transport with sufficient care, have frequently led to mechanical damages, even to fracture of the glass substrates.

SUMMARY OF THE INVENTION

[0004] In view of this, it is a first object of the invention to disclose a container for the storage and transport of sensitive plate-like objects which reduces the risk of mechanical damage of plate-like objects received therein.

[0005] It is a second object of the invention to disclose a container for the storage and transport of sensitive plate-like objects which reduces the risk of contamination of the plate-like objects received therein.

[0006] It is a third object of the invention to disclose a container that is particularly suited for the storage and transport of delicate glass substrates or biochips.

[0007] It is a fourth object of the invention to disclose a container that is easy to manufacture and assemble in a cost saving way.

[0008] It is a fifth object of the invention to disclose a container allowing an easy handling of objects received therein.

[0009] These and other objects are solved by a container having an upper part and a lower part which are connected with each other by connecting elements, wherein the lower part comprises two lateral sides, two longitudinal sides and a bottom, which commonly enclose a cavity for receiving plate-like objects therein, wherein at each of the lateral sides a series of first ridges extending perpendicularly to the bottom and defining a plurality of guide grooves for the plate-like objects is formed, wherein the upper part comprises an inner surface being parallel to the bottom when the container is closed, and wherein at least one protruding second ridge is formed at the inner surface extending in parallel to the two lateral sides across the total inner surface and thus limiting the movability of the plate-like objects within the guide grooves.

[0010] Thus, the container according to the invention comprises a container lower part having a plurality of guide grooves into which a glass substrate, or in broader terms a plate-like object, is inserted. In this way, several adjacent glass substrates are held at a distance from each other, this eliminating the risk of contact friction and/or striking one upon the other. Accordingly, the guide grooves serve to reduce the risk of mechanical damages. However, it has been found that the guide grooves are not sufficient to fully meet the demands with respect to the storage and transport of surface functionalised glass substrates. Namely, usually there remains a cer-

tain play of movement, even if the glass substrates are inserted into the grooves. Although the guide grooves preferably are only insignificantly broader than the thickness of the glass substrates, usually a certain small play remains. If the guide grooves were designed even smaller, it would be difficult to insert the glass substrates precisely and without damage into the guide grooves.

[0011] Now, the inventors of the present invention have found that due to the movements possible in view of the play may lead to a material abrasion within the guide grooves, caused to some extent by sharp edges of the glass substrates. As a result, smallest plastic particles may deposit onto the sensitive surfaces of the glass substrates, this increasing the undesired contamination mentioned before. Therefore, according to the invention, at the inner surface of the upper part which extends in parallel to the bottom and thereby perpendicularly to the guide grooves, at least one protruding second ridge is formed which limits the movability of the glass substrates, at least along the guide grooves. A "hopping around" of the glass substrates within the container is reduced thereby. Preferably, the second ridge protrudes thus far that it contacts the upper edge of the received glass substrates, when the container is closed, whereby a "hopping around" within the guide grooves is almost completely impaired, as well as any lateral movement within the guide grooves.

[0012] Also the reduced movability serves to reduce the risk of mechanical damage.

[0013] According to another embodiment of the invention the container comprises at least one pair of second ridges that are located at the inner surface of the upper part, the second ridges defining a press fit for receiving a first damping strip in parallel to the lateral sides, or alternatively, the container comprises a damping element that is located at the bottom of the lower part, the damping element being positioned by resting against the lateral sides and against the longitudinal sides.

[0014] In this way damping material can be exactly positioned either at the upper part or at the lower part or at both parts in a simple way without using any adhesive.

[0015] To this end at the upper part a press fit between two ridges is used for receiving the at least one damping strip.

[0016] If the damping material shall be included in the lower part, then a damping element is used that is exactly positioned on the bottom of the lower part by resting against the lateral sides and against the longitudinal sides. A press fit is possible but not mandatory, since the damping element is located by a form fit between the lateral and longitudinal sides and cannot fall out due to its location on the bottom.

[0017] If the damping element located at the bottom is used, suitably it comprises two damping strips extending along the lateral sides and enclosed between the longitudinal sides, the two damping strips being connected by at least one linking strip.

[0018] According to a further development of this configuration the damping element is configured H-shaped.

[0019] This serves to ensure a form fitted positioning of the damping element in a simple way. Also a good support of the glass substrates at their front faces is ensured while the contact surface is kept considerably small.

[0020] Obviously, also the glass plates inserted in the container may be supported at the bottom side and at the top side by damping material.

[0021] Basically, the advantages mentioned above could also be reached by gluing a suitable damping strip, or in broader terms, a damping material, onto the inner surface of the upper side and/or onto the bottom. However, the preferred embodiment having a strip-shaped damping element received in press-fit or in form-fit offers the advantage that a contamination of the sensitive surfaces of the glass substrates by gas evolution from the adhesive is avoided.

[0022] According to another embodiment according of the invention the container is designed such that the distance between the two lateral sides between each other is larger than the height of each individual lateral side above the bottom.

[0023] These dimensions of the container lead to the consequence that the glass substrates, more generally the plate-like objects, are inserted into the guide grooves with their slim sides. Put in other words, the glass substrates according to this development of the invention are transported

in a "lying" state. This feature facilitates inserting of the glass substrates into and removal of the glass substrates out of the container without contamination and damage. Also this feature serves to reduce the contact surface between the sensitive surfaces of the glass substrates and the first ridges which form the guide grooves, this further reducing the risk and the extent of possible damages.

[0024] According to a further embodiment, the damping strips and or the damping element comprise the material polytetrafluoroethylene.

[0025] In practical tests, this material has been found to be particularly suited, since it offers the desired damping characteristics and also does not show any significant gas evolution. In addition, this material is known as an anti-friction material which facilitates sliding of objects along a surface thereof, thus avoiding abrasion caused by any sharp edges. Also the risk of mechanical damage of the sensitive edges of the glass substrates in the region of the contact surfaces is small when using this material.

[0026] According to a further preferred embodiment, the upper part and the lower part are connected with each other being separable in an indestructible way.

[0027] Put in other words, according to this embodiment the upper part can be fully separated from the lower part. Thereby, the glass substrates can be inserted particularly simply into the container or removed there from, respectively. In particular, owing to this measure also a particularly simple

an damage-free filling of the containers in automatic packaging operations is possible.

[0028] According to a further embodiment, the connecting elements comprise at least a first hook-shaped part and at least a second pin-shaped part which commonly define a plug-in hinge, wherein a respective one of the parts is arranged at the upper part and at the lower part.

[0029] The design of the connecting elements as a plug-in hinge has been found to be a particularly advantageous embodiment when considering the handling of the container in combination with sensitive glass substrates. The plug-in hinge on the one hand allows a full separation of the upper part from the lower part, this offering the advantages mentioned above. On the other hand, the container, in particular, if opened only for a short time, can simply be swiveled. Finally, it has been found in drop tests that a plug-in hinge is particularly effective to avoid an undesired opening of the container under heavy impact load.

[0030] According to a further embodiment, the at least one hook-shaped first part is designed so as to allow detaching from the pin-shaped second part by translational motion at an opening angle of more than 135°.

[0031] Also this embodiment of the plug-in hinge has been found to be particularly advantageous to avoid an undesired opening of the container under high impact load. On the other hand, an opening angle of more than 135°, preferably of about 145°, is well-suited to allow a simple detaching of the

upper part from the lower part. All in all, this embodiment thus provides a high operating convenience for the novel container.

[0032] According to a further embodiment, the at least one hook-shaped first part is designed tapering conically toward its end section.

[0033] This embodiment offers the advantage that the plug-in hinge is self-centering when putting together the hook-shaped and the pin-shaped parts, thus being a self-centering plug-in hinge. The putting together of the upper part and the lower part and thereby the closing of the container, is facilitated thereby, and is also made possible using only one hand.

[0034] According to a further embodiment, the connecting elements further comprise a locking mechanism having a closure lug being designed to positively engage around a locking protrusion being arranged at a first container outer side.

[0035] Such a locking mechanism has been found to be particularly effective in combination with the plug-in hinge to avoid an undesired opening of the container under impact load. In addition, such a closure lug facilitates a high operating convenience in combination with the plug-in hinge mentioned above.

[0036] According to a further development, at at least one second container outer side no suitable locking protrusion is formed, and the lower part is further designed so as to

allow receiving the upper part in a position in which the closure lug rests against the second container outer side.

[0037] This particularly preferred embodiment serves to further improve the handling of the novel container. Thus, due to this embodiment it is easily possible to place the upper part onto the lower part only "loosely". Thus, the container can be closed without locking it. In particular, this measure serves to ensure that an operator immediately closes the container after removal of a single glass substrate, this further reducing undesirable contaminations of the sensitive glass substrates.

[0038] With this embodiment in practical operation it is generally important to design the upper part and the lower part with respect to each other so as to allow putting together in at least two different orientations with respect to each other. This includes that on the one hand a respective symmetry is provided and/or that suitable recesses are provided at all places, where protruding parts would otherwise impair putting together the upper and the lower part. Such a particularly preferred reduction to practice is described below by reference to an exemplary embodiment.

[0039] According to a further embodiment of the invention, the container is made of polystyrene and/or a homopolymeric plastic.

[0040] These materials have been found to be particularly advantageous, since they tend to evolute only small amounts of gases. Preferably only small amounts of additives

are utilized at the most. The risk of undesired contamination of the sensitive surfaces of the glass substrates by chemical processes is further reduced.

[0041] According to a further embodiment, the first ridges are rounded at their upper sides facing away from the bottom.

[0042] This measure particularly serves to facilitate inserting of the sensitive glass substrates into the guide grooves. The risk of damage is further reduced.

[0043] It will be understood that the features mentioned above and to be explained hereinafter may not only be used in the given combination but also in other combinations or exclusively without going beyond the scope of the invention.

SHORT DESCRIPTION OF THE DRAWINGS

[0044] A preferred embodiment of the invention is shown in the drawings and will be described hereinafter. In the drawings:

[0045] Fig. 1 shows a container according to the invention, wherein the upper part and the lower part rest adjoining each other are shown in swung open position;

[0046] Fig. 2 shows a cutout enlargement of the first ridges and the guide grooves within the lower part of the container of Fig. 1;

[0047] Fig. 3 shows a lateral view of the container of Fig. 1 when placing the upper part;

[0048] Fig. 4 shows a front view of the upper part and the lower part of the container of Fig. 1;

[0049] Fig. 5 shows the upper part and the lower part of Fig. 1, wherein the upper part has been pivoted by 180°; and

[0050] Fig. 6 shows a lateral view of the container of Fig. 5, wherein additionally the location of a received glass substrate is indicated.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0051] The subsequent description and exemplary embodiment of the novel container is designated in total with reference numeral 10. The container 10 comprises an upper part 12 and a lower part 14, which can be completely detached from each other as will be shown in the following. In the closed state of the container the upper part 12 rests against the lower part 14. The glass substrates to be received, or more generally, the plate-shaped objects, herein are inserted into the lower part 14 in a way to be explained hereinafter. The upper part 12 serves as some kind of top.

[0052] As shown in Fig. 1, the lower part 14 comprises two lateral sides 16, 18, two longitudinal sides 20, 22 as well as a bottom 24. In combination the four afore-mentioned sidewalls and the bottom define a cavity 26 which serves to receive

plate-shaped objects, in particular, to receive surface functionalised glass substrates. For the sake of simplicity the following description only relates to glass substrates. However, it should be noted that the scope of application of the container 10 is not limited thereby. By contrast, the disclosed preferred container 10 can also serve to receive prior art microscope object holders, to receive complete so-called biochips or to receive and store other plate-shaped objects, the dimensions of which correspond to those of prior art object holders.

[0053] At each of the two lateral sides 16, 18 of the lower part 14 a series of first ridges 28 is provided between which guide grooves 30 are formed. According to the preferred exemplary embodiment currently described, the first ridges 28 are designed integrally with the respective lateral sides 16, 18. Put in other words, the first ridges 28 are formed already at the lateral sides 16, 18 during manufacture of the lower part 14.

[0054] The guide grooves 30 serve for receiving a glass substrate each, respectively, of which in Fig. 1 three ones are shown exemplarily. Herein, one of the glass substrates is depicted with numeral 32.

[0055] As can be seen in Fig. 1, the distance between the lateral sides 16, 18 is only slightly larger than the length of the glass substrates 32 to be received. By contrast, the depth of each guide groove 30 is small when compared to the length of the glass substrates 32, i.e. the glass substrates 32 protrude only with a somewhat smaller rim region at their front

faces into the guide grooves 30. The smaller contact surface helps to avoid contamination and damage.

[0056] At the bottom 24 of the lower part 14 below the glass substrate 32 an H-shaped damping element 34 is located. The damping element 34 comprises two damping strips 36, 38 which extend in parallel to the lateral sides 16, 18 across the total width of the lower part 14. Both damping strips 36, 38 are connected with each other by a linking strip forming the middle of the "H". In addition, the two damping strips 36, 38 extend directly adjacent to the first ridges 28, so that the complete damping element 34 is always held in a defined position by a form fit. Herein the damping element 34 is a polytetrafluoroethylene material, i.e. a strip made of Teflon®.

[0057] Herein, the damping element 34 is simply placed on the bottom 24 of the lower part 14, without any particular attachment. However, alternatively the damping element 34 could also be mechanically attached to the bottom 24. Beyond that, also another shape different from the H-shape here preferred could be used, while the shape here disclosed offers a good compromise between a small contact surface to the glass substrates 32 and a simple positioning.

[0058] Reference numeral 40 designates a scale that extends at the bottom 24 of the lower part 14 roughly in the middle between the two lateral sides 16, 18 and in parallel thereto. On the scale numerical values are depicted "numbering" the individual support locations for glass substrates 32. Thus, utilizing the scale 40, the number of glass substrates 32 received within the lower part 14 can be detected relatively

simple. In the example shown here, the container is designed for receiving 25 glass substrates. Beyond that also broader containers are provided for receiving 50, 100 or even more glass substrates, if necessary. However, preferably the container 10 is designed so as to receive at least 15 glass substrates, since it has been found that this is an economically feasible size for such a container.

[0059] Reference numerals 42 and 44 depict two pin-shaped parts that are formed at the outer side of lateral side 16. On the other hand, at the opposing lateral side 18, a locking protrusion 46 as well as two deepenings or recesses 48, 50 are formed. The size of these deepenings 48, 50 can be seen in the two front views of the lower part 14 in figures 4 and 5.

[0060] The upper part 12 comprises four side walls 56, 58, 60, 62 which rest flush on the two lateral sides 16, 18 and the longitudinal sides 20, 22 of the lower part 14 when the container 10 is closed. With reference numeral 64 the (inner) surface of the upper part 12 is depicted extending in parallel to the bottom 24 of the lower part 14 when the container is closed. Thus, in the closed state the container 10 has a closed hypoid form.

[0061] Reference numerals 66 and 68 depict two hook-shaped parts arranged at the side wall 58 protruding to the outside. The hook-shaped parts 66, 68 together with the pin-shaped parts 42, 44 form two plug-in hinges at the lower part 14, the function to be described hereinafter with reference to Fig. 3. In the preferred embodiment shown here the two hook-shaped parts 66, 68 each taper conically toward their respec-

tive end regions 69. This simplifies putting together the plug-in hinges.

[0062] At the opposite side wall 56 a closure lug 70 is located protruding to the outside and being designed such that it can positively enclose the locking protrusion 46 located at the lateral side 18 of the lower part 14. Thus the closure lug 70 and the locking protrusion 46 form a locking mechanism for the container 10.

[0063] According to a particularly preferred feature of the present invention at the inner surface 64 of the upper part 12 in total four second ridges 72 extend in parallel to the side walls 56, 58 (and thus in parallel to the lateral sides 16, 18, of the lower part). The four second ridges 72 define two pairs of ridges in total. Each pair of ridges defines a press fit for a damping strip 74, 76. Herein, the damping strips 74, 76 are made of the same material as the damping element 34 in the container lower part 14. Alternatively, the container 10 could also be used without the damping strips 74, 76, the second ridges 72 limiting the "range of movability" of the glass substrates in this case.

[0064] In the preferred embodiment shown here the thickness of the damping element 34 and the thickness of the damping strips 74, 76 is selected so that they rest against the upper and lower edges of the glass substrates 32 when the container 10 is closed. Thus, the glass substrates 32 are held within the guide grooves without play. Thereby, any undesired material abrasion is substantially avoided, in particular at the first ridges 28.

[0065] Now, with respect to the following figures, first the details of the preferred container 10 will be described. Herein, like reference numerals are used for like elements as in Fig. 1.

[0066] In Fig. 2, the preferred embodiment of the first ridges 28 is shown in a (partial) top view onto the container inner side of the lateral side 16. As can be seen, the ridges 28 each have a top side 82 rounded downwardly which facilitates the insertion of the glass substrates 32 into the guide grooves 30. In addition, also the risk of damage during insertion is reduced.

[0067] The ridges 28 extend downwardly up to the bottom 24 of the lower part 14. However, at the top the ridges 28 are somewhat shorter than the height H which again facilitates the insertion of the glass substrates 32. The distance of two adjacent ridges 28 from each other here is 1.4 mm which is somewhat larger than the thickness of the glass substrates 32 to be received. A lateral play 32 within the guide grooves 30 thus existent is removed based on the embodiment according to the invention in particular by means of the damping strips 36, 38 that are utilized.

[0068] In figures 3 and 4 the steps and motion patterns necessary for a safe closing of the container 10 are indicated by the aid of arrows. In the first step, the upper part 12 is placed with the two hook-shaped parts 66, 68 from the top, i.e. in the direction of arrow 86, onto the pin-shaped parts 42, 44 of the lower part 14. Herein, the upper part 12 is pivoted with respect to the lower part 14 by an opening angle of about 145°

or more. After placing the hook-shaped parts 66, 68 onto the pin-shaped parts 42, 44, the upper part 12 can be pivoted into the direction of arrow 88 toward the lower part 14. The overall motion pattern is again shown in Fig. 4 by means of an arrow 90.

[0069] In addition, it can be seen from the representation of the container 10 in figures 3 and 4 that four protrusions 92 are provided at the lower side of the lower part 14, namely preferably at the four (rounded) corners of the lower part 14. At the respective positions of the upper side of the upper part 12 recesses 94 are provided being dimensioned such that the protrusions 92 can precisely engage therein. Thereby, a particularly stable and reliable pile stacking of several containers 10 is made possible.

[0070] In addition, it can be seen from the representation of Fig. 4 that a recess 96 is arranged at the lower part 14 below the locking protrusion 46. This recess allows an easy detaching of the closure lug 70 when it encloses the locking protrusion 46 with an opening 98 while the container 10 is closed. Thereby, the opening of the container 10 is facilitated.

[0071] In the representation of Fig. 5 the upper part 12 is pivoted by 180° with respect to the position of Fig. 4. The closure lug 70 thus is at the rear and the two hook-shaped parts 66, 68 lie in the front. The recesses 48, 50 are designed such that they can receive the protruding sections of the hook-shaped parts 66, 68, if the upper part 12 is placed onto the lower part 14 in the direction of an arrow 100. Since the lower

part 14 does not have any locking protrusion mated to the locking protrusion 46 at its lateral side 16, in this way a simple closure of the container 10 is possible without locking it. Thereby, in particular a short-time closing of the container 10 between individual removals of glass substrates 32 is facilitated.

[0072] Fig. 6 shows the same motion pattern as Fig. 5 from a lateral perspective. Here, in addition, a seating of a glass substrate 32 received within the lower part 14 is depicted schematically. As can be seen, the glass substrate 32 rests against the damping strips 36, 38 and protrudes beyond the lateral and longitudinal sides 16, 18, 20, 22 of the lower part 14, so that the second ridges 72 and possibly the damping strips 74, 76 come to rest against the upper edge of the glass substrate 32 when the container is closed.

[0073] As can be seen from the figures shown here, in particular from figures 1 and 6, here the container 10 has inner dimensions that are matched precisely to the size of the glass substrates 32 to be received. The container 10 shown here is designed for a standard format of glass substrates 32 being from 25 x 75.5 x 1 mm to 26 x 76 x 1,3 mm. Herein, the outer packaging dimensions are 90 x 80 x 30 mm, and the container 10 thus serves to receive a maximum of 25 glass substrates 32.

[0074] A container 10 of the design disclosed here has successfully passed drop tests from a height of four meters, i.e. the container 10 does not open itself under the impact loads resulting there from. In addition, the glass substrates 32 can be quite simply automatically inserted and removed while

the upper part 12 is removed, this facilitating an automatic processing of glass substrates under highly clean conditions. Due to the utilization of materials free of gas evolutions, in the present case polystyrene having a small part of additives, and due to the mounting of the Teflon strips without any adhesive, surface functionalised glass substrates may be stored within the container 10 for a storage time of up to six months without any significant subsequent contamination. Also during transport and handling of the container 10, there are no subsequent contaminations, since any material abrasion is avoided by means of the precisely fitted storage and damping of the glass substrates 32.

[0075] What is claimed is: